# Seasonal Observations on Diet, and Stored Glycogen and Lipids in the Horse Clam, *Tresus capax* (Gould, 1850)

BY

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(Plate 57; 1 Text figure)

## INTRODUCTION

A study of two bivalves, *Lima hians* (Gmelin, 1791) and *Mya arenaria* Linnaeus, 1758 revealed the presence of fat globules in the digestive diverticula of these animals (Reid, 1966). Although glycogen is generally regarded as the major food storage compound in the Bivalvia, the fat contained in the digestive diverticula represents a significant amount of food energy. It was of interest therefore to undertake a seasonal study of the diverticular lipid as it related to lipid and glycogen storage in the gonad, which is the major organ of food storage, in the hope that the following questions might be answered: does the lipid of the digestive diverticula increase with an increase in food, or is it kept constant by the transport of excess lipid to the gonad? Does the diverticular fat represent a final energy store, to be depleted when the gonad glycogen and lipid are exhausted, or does the level of diverticular fat fall along with the level of glycogen and fat in the gonad? The seasonal availability of food was relevant to these problems and a study of the diet was undertaken along with stored food observations.

## MATERIALS and METHODS

Specimens of *Tresus* (=*Schizothaerus*) *capax* (Gould, 1850) were dug at Esquimalt Lagoon, near Victoria, B. C. The average age of the animals was 4 years. They were collected at each spring tide over the period of a year, from July 1966 to June 1967. Adverse tidal and weather conditions made it occasionally impossible to collect, and sometimes limited the number of animals collected to two. The maximum number of animals sampled at any collection time was 6, though the general condition of the gonads of all the animals dug was observed.

Bearing in mind the admonition of Mansour (1946) that digestion of some of the diet components in bivalves may be so rapid that any delay between collecting and examination of the stomach contents might give a wrong impression about diet, the stomach contents during the first few collections were examined on the beach, minutes after the animals were dug. It soon became obvious that a delay of many hours made little difference to the qualitative aspects of the stomach contents, and subsequent observations were made in the comfort of the laboratory. The stomach contents of animals which were dug while still covered with several feet of water during the ebb of the tide were also examined to compare actively feeding animals with those which had been exposed to the air for some hours. Within 12 hours of collection of the animals plankton samples were taken in the vicinity of the *Tresus* bed to determine the degree of selection exercised by the animals.

Lipid from the digestive diverticula and gonad was estimated by the chloroform/methanol extraction method of Folch *et al.* (1957). Glycogen was estimated by the anthrone method of Viles & Silverman (1949) after extraction with 5% trichloracetic acid at 90° C.

The digestive diverticula were usually invested with gonad tissue and it was difficult to separate the two tissues completely. This problem was surmounted thus: a previous histochemical study (Reid, 1968) indicated that glycogen is absent from the digestive diverticula proper. Thus the glycogen value obtained from the diverticula must have come from investing gonad. Therefore, applying the glycogen:lipid ratio obtained from the gonad proper, the % dry weight of lipid derived from investing gonad could be subtracted from the diverticular lipid value to obtain the true lipid value.

It should be observed here that the histochemical observation on *Tresus* diverticular fat included in the author's 1968 paper was false, due to a technical mishap, but that the observations on the other species were valid.

## RESULTS

### Stored Lipid and Glycogen

The results presented in Table 1 are graphed in Text figure 1, with different scales for average % dry weight lipid (left hand ordinate) and average % dry weight glycogen (right hand ordinate). Proceeding chronologically

Table 1

Percent dry weight of gonad lipid, diverticular lipid, and gonad glycogen of *Tresus capax*, averaged for all individuals collected.
[* = sample lost through technical error]

| Date | Gonad Lipid | Diverticular Lipid (corrected value) | Gonad Glycogen |
|---|---|---|---|
| July 19 | 13.0 | 11.7 | 83.0 |
| August 15 | 11.3 | 13.3 | 77.3 |
| September 12 | 15.5 | 12.5 | 63.9 |
| October 5 | * | * | 63.9 |
| November 16 | 14.0 | 9.5 | 52.4 |
| December 1 | 15.7 | 9.0 | 44.2 |
| December 15 | 18.0 | 10.2 | 33.2 |
| December 28 | 13.3 | 10.2 | 3.2 |
| January 9 | 13.7 | 10.6 | 3.4 |
| January 24 | 11.8 | 8.8 | 10.4 |
| February 7 | 14.2 | 8.3 | 19.5 |
| February 22 | 13.3 | 10.6 | 19.8 |
| March 6 | 8.1 | 10.0 | 2.8 |
| March 23 | 8.7 | 6.5 | 6.8 |
| April 13 | 12.8 | 7.2 | 1.1 |
| April 27 | 9.9 | 12.1 | 18.8 |
| May 10 | 10.4 | 11.7 | 16.6 |
| May 24 | 8.88 | 10.6 | 20.6 |
| June 10 | 12.7 | 9.9 | 9.3 |
| June 24 | 11.5 | 11.7 | 60.1 |

a falling off in glycogen begins about the end of July, 1966, the curve steepens in December and rapidly falls to a minimum value at the beginning of January. Rising temporarily during February it falls to a new low which lasts throughout March and part of April. Then the glycogen content begins to rise, interrupted by a slight

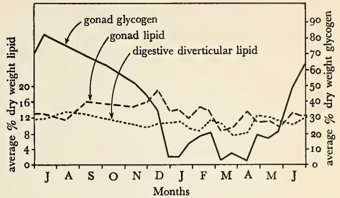



Figure 1

Graph of average % dry weight of gonad glycogen and lipid, and digestive diverticular lipid, in *Tresus capax*, over the period July 1966 to June 1967

dip in the beginning of May, to rise finally to the peak in July.

Both digestive diverticular and gonadal lipid are fairly similar in their progress. However, during November there is a slight rise in gonad lipid to reach the highest peak of the year, while the digestive diverticular lipid falls slightly. Both organs reach a low in lipid content which coincides with the second low in glycogen content, recovering in step with the glycogen halfway through April. In May the gonad lipid drops along with the glycogen, but the lipid in the digestive diverticula shows less of a dip at the same time.

Incidental observations on the general condition of the gonads of all the animals collected are included in Table 2, along with the diet observations. From these observations it seems that individual animals vary considerably during the period December to March in the amount of stored material (i. e., in degree of fatness). Since an average of 4 animals only was sampled at each collecting time over the year it looks as if this number of animals is too small to make the individual differences insignificant, and so the first low and the small peak in glycogen content during February is probably not indicative of the general trend throughout the population. Thus it is likely that a larger sample would have the glycogen content of the gonad falling smoothly from July to March.

### Diet

Observations on diet and available phytoplankton are detailed in Table 2. Typical summer and winter stomach contents are shown in Plate 57. Naked flagellates are almost impossible to identify after exposure to the gastric juice of the clam, since they immediately become distorted and the flagellae are no longer obvious. Wherever

Table 2

Comparison of stomach contents of *Tresus capax* with available phytoplankton in the sea; notes on the general condition of the gonads of all animals collected

| Date | Stomach Contents | Phytoplankton not in Stomachs | Ratio of fat: thin:depleted gonads |
|---|---|---|---|
| June 20 | Many *Fragilaria*; colonial *Navicula*; various diatoms; detritus | 0 | 4 : 2 : 0 |
| June 30 | Mainly *Fragilaria*; detritus | 0 | 7 : 2 : 0 |
| July 18 | Mainly *Melosira* | 0 | 6 : 0 : 0 |
| August 15 | Various diatoms and flagellates | 0 | 4 : 0 : 0 |
| August 27 | *Melosira*; *Meridion*; many flagellates | peridinians | 5 : 0 : 0 |
| September 1 | Various diatoms | 0 | 6 : 0 : 0 |
| September 12 | *Meridion*; *Gomphonema*; *Melosira*; many flagellates | peridinians | 4 : 0 : 0 |
| October 5 | *Meridion*; *Gomphonema*; *Melosira*; many flagellates | *Coscinodiscus* | 7 : 0 : 0 |
| November 2 | Various diatoms; flagellates | *Coscinodiscus* | 5 : 2 : 0 |
| November 16 | A few, varied diatoms | 0 | 2 : 2 : 0 |
| December 5 | A few *Melosira*; flagellates | *Gyrosigma*; *Triceratium*; *Isthmia*; *Chaetoceras*; *Coscinodiscus* | 1 : 3 : 0 |
| December 15 | Mainly detritus | As December 5 | 0 : 2 : 4 |
| December 28 | Mainly detritus; a few varied diatoms; flagellates | As December 5 | 0 : 2 : 5 |
| January 8 | Mainly detritus; a few varied diatoms; flagellates | peridinians; *Coscinodiscus* | 0 : 1 : 5 |
| January 24 | Mainly detritus; a few varied diatoms; flagellates | *Biddulphia arctica* | 0 : 2 : 4 |
| February 7 | Mainly detritus; a few varied diatoms; flagellates | *Biddulphia arctica* | 0 : 3 : 1 |
| February 22 | Mainly detritus; a few varied diatoms; flagellates | 0 | 0 : 1 : 1 |
| March 6 | Many *Biddulphia aurita* | 0 | 0 : 0 : 2 |
| March 22 | Various diatoms | *Chaetoceras* | 0 : 1 : 1 |
| April 15 | Many varied diatoms | 0 | 0 : 1 : 3 |
| April 27 | Many small diatoms | 0 | 0 : 3 : 1 |
| May 10 | Many *Fragilaria*; *Melosira* | 0 | 0 : 2 : 0 |
| May 24 | Many *Fragilaria*; *Melosira* | 0 | 0 : 2 : 0 |
| June 10 | Many *Fragilaria*; *Melosira* | 0 | 1 : 2 : 0 |
| June 24 | Many, varied diatoms | 0 | 2 : 2 : 0 |

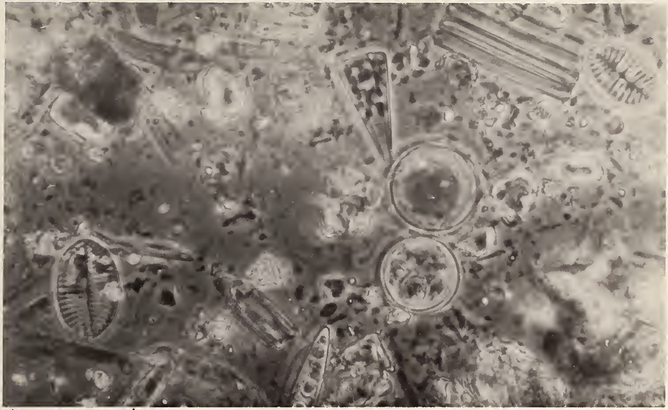
possible diatoms are identified to genus and occasionally to species.

In summary, there are a number of larger diatoms (with large cell bodies, or made effectively large by possessing many long spines) such as *Coscinodiscus, Chaetoceras,* and *Isthmia* species, and *Biddulphia arctica* (Brightwell, 1853) which commonly occur in the region of the clam beds, but which the animals do not ingest, presumably because of their large size, being selected out and rejected by the sorting mechanisms of the mantle cavity. At times there are also large peridinian dinoflagellates which are available to the clams, and which would seem to be within the upper limits of the acceptable particle size ($150 \mu$), but which are not ingested, for reasons unknown. For the most part *Tresus* ingests all of the other smaller phytoplankton members, any bloom of a particular species being reflected by the stomach contents. Some time in November the amount of the food in the stomachs was noticeably reduced from the earlier part of the year, and from December to the end of February most of the particulate material in the stomach was inorganic or detrital. As early as March 6 the first phytoplankton bloom, of *Biddulphia aurita* (Lyngbye, 1819) appeared, and the quantity of phytoplankton found in the stomachs gradually increased into June where it seemed to level off.

## Explanation of Plate 57

Figure 1: Stomach contents of *Tresus capax,* collected July 1966; various diatom species; flagellates

Figure 2: Stomach contents of *Tresus capax,* collected December 1966; several flagellates; diatom frustules; *Cristispira*



50μ

Figure 1

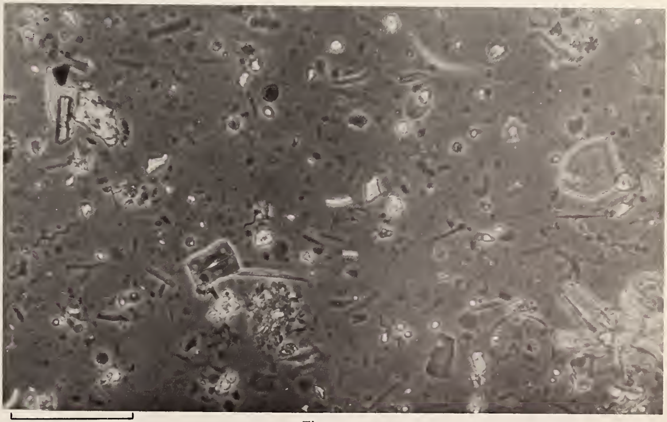


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Figure 2